

SECTION 16482  
MOTOR CONTROL CENTER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. AC motor control center rated 600V and less.

1.2 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70 - *National Electrical Code*.
- B. Furnish products listed and labeled by Underwriters Laboratories, Inc., as suitable for purposes specified and shown.

1.3 SUBMITTALS

- A. Provide the following submittals according to the requirements of Sections 01300 and 01700.
1. Catalog Data: Submit catalog data for each product and component specified proving that materials comply with specified requirements. Include features, characteristics, ratings, and factory settings of individual MCC units.
  2. Shop Drawings: Submit shop drawings for each MCC including dimensioned plans and elevations and component lists. Show ratings, including short time and short circuit ratings, and horizontal and vertical bus ampacities. Include: front and side views of enclosure showing overall dimensions, enclosure type, enclosure finish, unit locations, and conduit entrance locations.
  3. Wiring Diagrams: Submit interconnecting wiring diagrams pertinent to the class and type specified for the MCC. Submit a schematic diagram of each type of controller unit supplied.
  4. Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
  5. Operation and maintenance instructions.
  6. Recommended spare parts.

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**Edit 7 to match Project requirements.**  
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7. Certifications: Submit certification that motor control center and starter units meet applicable seismic requirements.

1.4 QUALITY ASSURANCE

- A. Motor control center manufacturing facility shall be ISO 9001 or ISO 9002 certified and shall have a documented record of at least ten major installations within the last five years.

## 1.5 COORDINATION

- A. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, load, the pilot device, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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### **Edit A to match Project requirements.**

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- A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path.
- B. Inspect motor control center upon delivery and report concealed damage to the carrier within their required time.
- C. Handle motor control center according to NEMA ICS 2.3—*Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers*. Use factory-installed lifting provisions.
- D. Store motor control center in a clean, dry environment. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic. Store so condensation will not occur on or in MCC. Provide temporary heaters as required to prevent condensation.

## 1.7 EXTRA MATERIALS

- A. Furnish six spares of each size and type fuse required.
- B. Provide one spray can of touch-up paint that matches finish for each motor control center.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Provide motor control center as indicated on the Drawings that comply with UL Standard 485—*Motor Control Centers* and NEMA ICS 2—*Standards for Industrial Control Devices, Controllers, and Assemblies*.
- B. Provide products suitable for operation at 7500 ft. altitude.

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### **Edit C to match Project requirements. Use peak accelerations as follows for equipment mounted at grade: 0.2g for PC-1 facilities, 0.22g for PC-2 facilities, 0.31g for PC-3 facilities. Consult a structural engineer for equipment located at other than grade.**

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- C. Provide motor control center structure and starter units suitable and certified to meet all applicable seismic requirements of the Uniform Building Code for zone 2B application.
  - 1. Provide guidelines for installation and seismic anchoring based on testing of representative equipment.

2. The test response spectrum shall be based upon a 5% minimum damping factor, a peak of [0.2g][0.22g][0.31g]. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

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**Edit D to match Project requirements; typically use Class I, Type B..**

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- D. Motor control center wiring classification shall be [Class I, Type A] [Class I, Type B] [Class I, Type C] [Class II, Type B] [Class II, Type C], as defined in NEMA ICS 2.

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**Edit E to match Project requirements; typically use Type 1A for indoor installations.**

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- E. Provide NEMA [Type 1 (general purpose)] [Type 1A (gasketed general purpose)] [Type 12 (industrial duty)] [Type 3R non-walk-in (rainproof)] enclosure as defined in NEMA 250—*Enclosures for Electrical Equipment*, except as otherwise indicated.
- F. Provide sections with a short-circuit current rating equal to or greater than the available fault current, in RMS symmetrical amperes, indicated on the Drawings.
- G. Manufacturers:
1. Westinghouse/Cutler-Hammer, "Freedom 2100 MCC"
  2. Square D Company, "Class 8998 Model 6 MCC"
  3. Siemens, "Model 95 MCC"

## 2.2 STRUCTURE

- A. Provide vertical sections that are bolted together to form a rigid, self-supporting, free-standing assembly and are designed to permit future additions or rearrangement of control units.
- B. Design enclosure to be rodent proof with maximum ½" diameter unprotected openings.
- C. Fabricate individual vertical sections from 12 gauge minimum steel continuous top and bottom frames. These steel frames shall be connected by vertical members consisting of cold-rolled steel box-sills at each corner and 12 gauge minimum vertical C-channels.
- D. Removable lifting angles shall be provided on top of each MCC shipping section. Each shipping section shall also be mounted on steel channel sills.
- E. Vertical sections shall have a nominal height of 90 inches and width of 20 inches. The depth of all sections shall be 15 to 16 inches nominal.
- F. Each section shall be dead-front and dead-back construction. Rear access will not be necessary for inspection or maintenance. The structure arrangement shall be for front only mounting of units.
- G. Provide an adequate conduit entrance area on the top of each vertical. This opening shall be covered with a bolted flat plate which may be removed and drilled for cable entrance. Provide the bottom of each structure with a rectangular area for termination of conduit.
- H. Provide each vertical section with a top and a bottom horizontal wireway, each extending the entire length of the motor control center. Isolate the top horizontal from the horizontal bus bars with a grounded steel barrier.

- I. Provide openings in the sides of each vertical section at the top and bottom to permit a continuous horizontal wiring trough. End vertical sections shall have cover plates which can be easily removed to allow addition of future vertical sections.
- J. Provide each vertical section with a vertical wireway extending the full height of the structure. This wireway shall be completely barriered from the unit area, from the vertical bus area, and from adjacent vertical sections. The vertical wireway shall have its own separate hinged door. Provide wire tie retainers in vertical wireway.
- K. Doors shall be formed of 16 gauge steel or heavier, with all edges flanged 5/8 inches deep minimum. Doors shall be mounted on adjustable and removable pin type concealed hinges and so arranged that unit doors may be removed without disturbing unit doors above or below.

## 2.3 FINISH

- A. Paint enclosure and unit parts using an electrodeposition process. Interior and exterior surfaces as well as bolted joints shall have a complete finish coat on and between them. The paint process shall consist of cleaning, rinsing, phosphating, prepaint rinses, painting, post paint rinses, a bake cure, and cool down.
- B. Paint exterior surfaces with medium light gray acrylic enamel. Paint the unit interior surfaces white for greater internal visibility.
- C. All unpainted parts shall be plated for resistance to corrosion.

## 2.4 BUS BARS AND BRACING

- A. The main horizontal bus shall extend the entire length of the motor control center and be tin-plated copper with ampacity ratings as shown on the drawings.
- B. The vertical bus in each section shall be tin-plated copper with a current capacity of not less than 300 amps. The bus support system shall be high dielectric strength, low moisture absorbing, high impact material with ample creepage distance between bus bars.
- C. The bus assembly shall be braced to withstand the mechanical stress caused by fault currents of 42,000 sym. RMS amperes. All ratings shall be UL listed.
- D. Provide a continuous copper ground bus in all sections. This bus shall have a minimum current rating of 300 amperes, and shall be located in the bottom of the structure, with cable lugs at each end of the line-up. Provide a copper vertical ground bus which makes contact with the plug-in units before the bus stabs engage the vertical bus.
- E. Bolted connections at each bus joint shall be front accessible for servicing with a torque wrench. The location of all splices shall be indicated by a label located on the inside of the vertical wireway door.

## 2.5 ISOLATION AND INSULATION

- A. Horizontal bus access covers and vertical bus covers shall isolate the energized buses to guard against the hazard of accidental contact.
- B. Cutouts shall be provided in the vertical isolation barriers for stab connections to the vertical bus. A manual or automatic shutter mechanism shall close the cutouts when a plug-in unit is removed. The vertical bus shall be provided with phase isolation barriers.

- C. All units shall be isolated from one another, above and below, by unit support pans or steel barriers which remain in place when the units are withdrawn.
- D. Incoming line compartments shall be isolated from horizontal and vertical wireways by steel barriers.
- E. Units shall have a side barrier to provide isolation from the vertical wire-way.

## 2.6 UNITS

- A. Combination motor starter units, Size 1 through Size 4, as well as other electrical assemblies including feeder tap units through 225 amps shall be provided with appropriately rated stab assemblies for plug-in type construction. Starter units Size 5 and larger, as well as feeder tap units above 225 amps, shall be bolt-in construction.
- B. Each plug-in unit shall be supported and guided so that unit arrangement is easily accomplished. After insertion, each plug-in unit shall be positively held in place.
- C. An operator mechanism mounted on the unit shall provide the means for operating the breaker. This operator shall extend through an opening in the unit door and shall clearly indicate whether the disconnect is 'ON', 'OFF', or 'TRIPPED'. This indication shall function whether the compartment door is open or closed.
- D. With the disconnect in the 'ON' position, a mechanical interlock shall prevent opening of the unit door. This interlock shall be provided with a defeater so that authorized personnel may gain access to the compartment without interrupting service. This interlock shall also prevent unintentional closing of the disconnect when the compartment door is open, a second mechanical interlock shall prevent any possibility of removing or re-inserting the plug-in unit while the disconnect is in the 'ON' position.
- E. The operator mechanism design shall provide for padlocking the disconnect in the 'OFF' position with up to three padlocks.
- F. The operator mechanism shall be so designed as to allow easy access to the magnetic trip settings.
- G. Each unit shall be provided with a removable door mounted on removable pin type hinges which allow the door to swing open at least 110 degrees. Doors shall be removable from any location in the center without disturbing any other doors. The unit door shall be fastened to the stationary structure so that it can be closed to cover the unit space when the insert has been removed. The unit doors shall be held closed with 1/4 turn pawl type latches, designed to resist forces during fault conditions.

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### **Edit 2.7 to match Project requirements.**

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## 2.7 INCOMING MAIN AND FEEDER TAP UNITS

- A. Provide incoming main and feeder tap units as indicated on the Drawings.
- B. Overcurrent devices shall be 600 volt, molded case, thermal magnetic circuit breakers that conform to NEMA AB 1 - *Molded Case Circuit Breakers*.
- C. The UL listed interrupting capacity of the circuit breakers shall equal or exceed the maximum available fault current at the motor control center.

- D. Provide adequate space for terminating conductors No. 1/0 AWG and larger with compression lugs.

## 2.8 CIRCUIT BREAKER TYPE NON-REVERSING STARTER UNITS

- A. Provide plug-in units containing combination magnetic motor controllers with motor circuit protector disconnects as indicated on the Drawings.
- B. Motor circuit protector shall conform to NEMA AB 1 - *Molded Case Circuit Breakers*, with an integral instantaneous magnetic trip in each pole.
  - 1. Trip units shall be calibrated to coordinate with the actual locked-rotor current of the connected motor and the controller overload relays.
  - 2. Provide breakers that are factory assembled with the controller, interlocked with unit cover or door, and arranged to disconnect the controller.
  - 3. The UL listed interrupting capacity of the motor circuit protector shall equal or exceed the maximum available fault current at the MCC.
- C. Provide AC general purpose Class A magnetic, full-voltage, non-reversing controllers for induction motors rated in horsepower and conforming to the requirements of NEMA ICS 2 - *Industrial Control Devices, Controllers, and Assemblies*.
  - 1. Coil shall be of the encapsulated type, 120 volts, 60 Hz.
  - 2. Provide controllers of size and number of poles as indicated on the Drawings.
  - 3. Contacts shall be totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
  - 4. Provide not less than two sets of NEMA ICS 2 field convertible auxiliary contacts in addition to the seal-in contact.
- D. Provide solid-state overload units with the following characteristics:

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**Edit 1 to match Project requirements. Class 20 tripping is suitable for most applications.**

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- 1. NEMA Class 20 tripping characteristics
  - 2. Field selectable motor full load current.
  - 3. Ambient temperature insensitive.
  - 4. Phase loss protection.
  - 5. Manual reset after time delay.
- E. Provide heavy duty, 22 mm or 30 mm, metal operator, oil tight pilot devices as listed below with NEMA ICS 2, Form Z, A600 rated contacts. Mount pilot devices on a removable panel located on the starter, not on the compartment door; there shall be no conductors across the unit door hinge.

1. Push buttons:
    - a. Mushroom head, maintained action, turn-to-release STOP push-button.
    - b. Recessed, momentary contact START push-button.
  2. Push-to-test LED type indicating lights:
    - a. Red RUNNING pilot light.
    - b. Green STOPPED pilot light.
  3. Selector Switches: Rotary type HAND - OFF - AUTO.
  4. Provide legend plates for push-buttons, pilot lights and selector switches.
- F. Provide externally operable manual reset operator.
- G. Provide a control power transformer in each motor starter unit. The transformer shall have 120 volt secondary and sufficient capacity to operate starter coil and all connected pilot, indicating and control devices, plus 100 percent spare capacity. Provide fuses in primary and secondary circuits of transformer. Bond unfused leg of secondary to enclosure. Provide fuse blown indicating fuses mounted in fuse blocks.
- H. Adhere to accepted industry standards of neatness and bending radius for wiring of controller units. Use MTW (AWM) wire for control and power wiring. Install wrap-around wire markers at both ends on all control wiring.
- I. Mount pull-apart control terminal blocks near the bottom front of each unit to permit clear and easy access to the terminals. The location of the terminal blocks shall make it easy to disconnect and remove the unit without damage to wiring.
- J. Provide auxiliary control relays where indicated in the drawings. Relays shall be heavy-duty general purpose type, having 115 volt 60 Hertz operating coils.

## 2.9 IDENTIFICATION

- A. Provide an identification nameplate label for each unit, indicating either a catalog number or serial number description.
- B. On each vertical section, provide a stamped metallic identification nameplate, indicating serial number, bus rating and vertical section reference numbering. The nameplate shall be externally mounted near the center of the vertical wireway door of each section.
- C. Attach nameplates to the equipment using No. 6-32 sheet metal screws or approved alternate method.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install each motor control center in accordance with NEMA ICS 2.3 "Instructions for the Handling, Installation, Operation, and Maintenance of MCCs," and with the manufacturer's written installation instructions.
- B. Provide a minimum of 1/2 inch space between the back of motor control center and a wall;

provide a minimum of 6 inch space for damp locations.

- C. Anchor each motor-control center assembly to steel-channel sills arranged and sized in accordance with manufacturer's recommendations. Attach by bolting. Level and grout sills flush with motor-control center mounting surface.
- D. Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from MCC units and components.

### 3.2 CONCRETE BASE

- A. Install motor control center on a 4 inch high reinforced concrete housekeeping pad. Install sills on the pad as specified above.
- B. Refer to Section 16190 - ELECTRICAL SUPPORTING DEVICES.

### 3.3 CONNECTIONS

Tighten motor control center bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's installation instructions and torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A.

### 3.4 IDENTIFICATION

- A. Install electrical identification on motor control center and conductors according to Section 16195 ELECTRICAL IDENTIFICATION.
- B. At indoor locations, mark floor in front of motor control center to show ANSI/NFPA 70 required working clearances according to Section 16195 ELECTRICAL IDENTIFICATION.
- C. Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

### 3.5 CLEANING

Upon completion of installation, inspect interior and exterior of each motor control center. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

### 3.6 FIELD QUALITY CONTROL

- A. Inspect each installed motor control center for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.
- B. Upon completing installation of the system, perform the following tests; follow procedures in NETA ATS-1991—*Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*:
  - 1. Test insulation resistance of MCC buses; components; and of connecting supply, feeder, and control circuits. For components with solid-state devices or other sensitive components, perform tests in accordance with manufacturer's instructions.
  - 2. Make continuity tests of circuits.
  - 3. Inspect MCCs for defects and physical damage, testing laboratory labels, circuit



connections, and nameplate compliance with up-to-date system drawings.

4. Check MCC anchorage, external clearances, and alignment and fit of components including internal elements.
  5. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
  6. Perform visual and mechanical inspection and related work for motor control and protective devices.
  7. Verify ratings and settings of overload relays, motor circuit protectors, and overcurrent protective devices.
  8. Correct deficiencies before energizing equipment.
  9. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
- C. Refer to Section [16950] [16951] ELECTRICAL ACCEPTANCE TESTING for additional inspection, testing and calibration requirements.

END OF SECTION